SCRIPT WRITER
PROF. MARCELLO VEIGA

MERCURY IN ARTISANAL GOLD MINING
Once upon a time there was a family of ducks living in a remote rural area in Indonesia.

They worked hard planting bananas, but had no way to educate their son (Duckling).
Why does our family of 3 make only US$ 12 per day planting bananas?

My son, we make more than 71% of all people in the world, who make only US$ 10 per day.

Some friends told me that I should be an artisanal gold miner... I can find a Snow White.

This is dangerous... In the world thousands of artisanal miners die every year! Let me tell you how is gold mining...
Ducklings produce around 400 tonnes Au/a

Dinosaurs produce 3,000 tonnes Au/a and they are only interested in large gold deposits

Swans make probably 20-50 tonnes Au/a; they mine responsibly small deposits

A Dozen Largescale International Mining Companies

Very few Small & Medium-sized Responsible Mining Companies

Catterpilars are the Government agencies

16 million Artisanal Gold Miners

Ducklings produce around 400 tonnes Au/a

Sharks process the gold ore for the ducklings; they are somehow legal

Coyotes sell mercury and supplies to ducklings. Some have mineral titles; they are legal
The little Duckling didn't listen to his father and left home. After 2 months, he and his friends found... 

"GOLD"

...then the ducklings mined for 15 days but they did not have money to process the ore.

...then the duckling took the ore to a Processing Center

Can you extract the gold from this ore? 

Sure, my good friend, I will use mercury which is efficient and fast...

You pay me only for the Hg, not for the work I will do, but I will keep the tailings...OK?

...and the Shark extracted the gold for the duckling...

about 50% of mercury lost to the environment
...the shark processed the ore and gave the amalgam back to the duckling. Go home and burn this amalgam...but close all windows because the police can arrest you.

Amalgam with 60% Au and 40% Hg

Let's burn everywhere to get rid of the mercury.

Indonesia
The stupid ducklings left all gold for me. I will use cyanide...

- Sharks used cyanide to extract the residual gold from the tailings (with Hg)
- Hg(CN)₂ was formed and dumped into the rivers
- This Hg–CN complex accumulates in the kidneys of the aquatic animals

**Hg(CN)₂ (Mercury)**

Indonesia
After one year, he produced 300 g of Au making US$ 12,000/a ($33/day) as an average artisanal miner in South America.

But how about the pollution? Can mercury go far in the streams?

I can’t believe!! Tailings with Hg into the rivers??!

Mercury from AGM Goes Far Away in the River (160 km)

This mercury dumped by the artisanal miners far away is coming down with the tailings they dumped in the river.

Mercury content in the sediments
Problems with Hg Vapor

Is this guy nuts??

Indonesia

I am Mercury-Free. I am safe!!! My shirt protects me.

Has this shirt a magic power to filter mercury?

Indonesia, Photo CETEM

Goldshops Buying Gold in the Towns

GOLD SHOP

Shops buy retorted gold (doré) with 2-5% Hg or amalgams with 40-50% Hg.

Ecuador, Foto: C. Velasquez
When the gold is melted, the mercury is released in the stores and goes to the air of the town.

The goldshops are burning amalgams in the urban area!!!

Let’s analyze mercury in hair, urine, blood, nails, saliva, mucus, sneeze, dandruff, etc.

Ducklings told me they are more afraid of lead than mercury.

Which lead?

This
Let’s tell the ducklings they will die because of mercury.

Ducklings told me “that there are more people living from mercury than dying from mercury.”

Let’s make a scandal in the Press.

Illegal online sales driving mercury pollution crisis in Indonesia

Indonesia: Mercury, Gold and "Uncommon Diseases"

Indonesia: Govt. will eradicate use of toxic mercury in small-scale gold mining & health care sectors

Call a “good” journalist.

The New York Times

The Hidden Cost of Gold: Birth Defects and Brain Damage

Ducklings told me they have 2 kidneys and mercury is in only one.

Call the scientists. Tell the ducklings that mercury goes to the kidney.

Tell the ducklings that mercury is already in the fish.

Ducklings told me they are "machos", they don't eat fish, only beef.

The public has been informed of this mercury pollution. What a shame!!

Hahahah!! I don't care... My mercury sales are very good.

I don't care either. I'm making lots of money.

Effect of Mercury Exposure on Renal Function and Hematological Parameters among Artisanal and Small-scale Gold Miners at Sekotong, West Lombok, Indonesia

Ardiana Ekawanti and Baiq Dewi Krisnayanti

Mercury contamination in fish from gold mining areas in Indonesia and human health risk assessment

Zuleica C. Castilhos a, b,*, Paulo Rodrigues-Filho a, Ana Paula C. Rodrigues a, *, Roberto C. Villas-Blas b, Shefa Siegel c, Marcello M. Veiga d, Christian Beinhoff e

Science of The Total Environment Volume 368, Issue 1, 1 September 2006, Pages 320-325
Let’s try the Technological Approach

- Stop amalgamation of whole ore, let’s teach ducklings how to concentrate gold
- Demonstrate and train ducklings on different methods to extract gold from the ore without using mercury

Let’s try the Technological Approach

\begin{itemize}
  \item Stop amalgamation of whole ore, let’s teach ducklings how to concentrate gold
  \item Demonstrate and train ducklings on different methods to extract gold from the ore without using mercury
\end{itemize}

OK, they concentrated the gold, now how will they extract gold from the concentrates?

Leaching the concentrates: Cyanide, iodine-iodide, thiourea, thiosulphate

We don’t need to use cyanide or mercury. I was told the BORAX METHOD is a panacea

The more you concentrate, the more gold you lose. How will we tell ducklings they will lose 90% of the gold to have a yellow concentrate to be melted?
The main toxic component of cassava is linamarin which is a cyanogenic glycoside that forms HCN when hydrolyzes. The cassava we eat has 20 mg of cyanide/kg of cassava. Bitter cassava contains >100 mg cyanide/kg. Preliminary results at UBC lab resulted in 50-60% of gold recovery from concentrates.

Why the Technological approach is not working?
- Projects do not have continuity... New projects repeat the same mistakes as the previous projects.
- Ducklings are not consulted when projects are designed.
- Without a permanent training support (TRAINING CENTER?)... ducklings go back to the polluting methods.
- Ducklings do not have skills and funds to adopt concentration and leaching methods.

Let's try to leach gold with cassava.

What are we going to do now?
- Make more meetings with lots of food and wine.
- Let's make more laws.
- The FORMALIZATION LEGAL approach is the solution.
Call United Nations... let's make new international agreements

- The UNEP Minamata Convention (MC) controlling exports and imports of mercury entered into force on Aug. 16, 2017
- NO more Hg for AGM can be traded
- Indonesia signed the MC on Oct 10, 2013 and ratified Sept 22, 2017
- In 2014, Indonesian Law banned the use of Hg in artisanal gold mining

**INDONESIA ~ MERCURY IMPORT x EXPORT**

**IMPORT**

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Hey!!! What's going on? Indonesia already signed and ratified the Minamata Convention. How can they export mercury??!!

I am legal, I do what I want!

Hahaha!!!
You need to be FORMALIZED like the Swans! Pay taxes and be a responsible citizen!

Why me? *70% of Indonesians have INFORMAL work... What will I gain?

This is the LAW... go there and be formal

Hi, I am an artisanal miner and I want to be FORMALIZED

Very good...

please fill out these forms, hire a geologist, an engineer, a lawyer, open a bank account, show that you have credit, there are 5 steps to be formalized... You have to swear that you will not use mercury... Then you have to go to the Ministry of the ENVIRONMENT
Hello, I want to be FORMALIZED and they told me that I need an environmental permit.

You need to have:
- Water use permit
- Tailings management permit
- Permit to use oils
- Water quality analysis
- Design of water treatment plant
- And other 300 permits

6 months later

Oh... you came late. we already gave the concession to the T. Rex Mining Company.

These are the documents you asked me.

Oops! What I will do now?
Dad, the formalization didn't work. I lost my time and now I am more illegal than before.

Let’s plant bananas

Wait! I have many friends and I can help you! I transform dirty silver into clean gold.

The Formalization of Ducklings is not working. We gave all mineral titles to the Dinosaurs.

Don’t worry, now we call the Ducklings: ILLEGAL, INVADERS, CRIMINALS.

Hahaha!!!
Meanwhile... Sharks and Coyotes are happy

Yeah!! More laws will be good for us!!! Hg price is increasing

Nobody can touch us because.....

Meanwhile in the field

The Dinosaurs cannot work with so many ducklings and sharks on their properties...
...then one day a smart Caterpillar consulted the Ducklings

I prefer to learn better techniques to mine safer and efficiently

Do you want to learn new techniques to concentrate and leach gold and avoid mercury?

...the Caterpillar insisted with the Ducklings

If they allow me to mine in their areas and pay me more...OK!!!

What do you think about selling your ore to a company that can process it?

I will analyze and pay a good price for your ore

Then Dinosaurs must co-exist with Ducklings and help them to improve their mines
...we have to domesticate ALL OF THE SHARKS!

I will also buy the ores from the Ducklings paying at least 50% of the gold content. I will not use mercury anymore because I know it is inefficient.

I am a Swan now... can't you see?

The Sharks that do not want to become Swans, they will be...
A new tax system was created, in which no definition of miners’ type was needed.

Simple: If you produce more gold, you pay more tax.

There is no place for Coyotes.
**CO-EXISTENCE MODEL**

Mining is a Community Business

- Small-scale responsible miners selling ores
- Large-scale mine
- Village
- Jewelers
- Entrepreneurs
- Farmers

HELP
One day a Fairy transformed this wise caterpillar into a beautiful BUTTERFLY and everything started working.

Moral of the Story

Without education and capital Ducklings cannot evolve

... If Ducklings sell the ores to Swans and Dinosaurs, the mercury does not need to be used and the ducklings will make more money and be formalized.
Moral of the Story

Sharks can be converted into responsible Swans. They must be trained to use cleaner methods.

Not all Caterpillars can become butterflies ... but they should try.

Moral of the Story

- Without (permanent) education and organization, the current Formalization initiatives are only formalizing the pollution.
- The miners will not accept any solution if they do not see an economic benefit.
- Co-existence with owners of the mineral titles, that already have the concessions, is a key solution to eliminate the use of mercury.
**Contributor**

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Published by Global Opportunities for Long-term Development of Artisanal and Small Scale Gold Mining (ASGM) Sector: Integrated Sound Management of Mercury in Indonesia’s ASGM Project (GOLD-ISMIA) GOLD ISMIA is funded by GEF and is the planetGOLD project in Indonesia
website: www.goldismia.org
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Jakarta, 11 November 2020
MERCURY IN ARTISANAL GOLD MINING